DOCUMENT RESUME

ED 387 359 SE 056 937

TITLE Guide To Reform in Mathematics and Science Education: The Big Players.

INSTITUTION Southwest Educational Development Lab., Austin, TX. Southwest Consortium for the Improvement of Mathematics and Science Teaching.

SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.

PUB DATE 94

CONTRACT R168R20003-94

NOTE 10p.; A SCIMAST Project.

PUB TYPE Collected Works - Serials (022) -- Guides - Non-Classroom Use (055)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS *Educational Change; Elementary Secondary Education; *Federal Programs; *Mathematics Education; *Organizations (Groups); *Science Education

IDENTIFIERS *Reform Efforts

ABSTRACT

Many organizations, both public and private, are involved in the current push for reform in science and mathematics education. This guide to some of the players in science and mathematics education is selective, focusing on key players at the national level. It is designed to be used by teachers and parents to orient themselves to the ongoing reform efforts and to use the resources available in their areas so that they may make their concerns and interests part of the changing landscape. The organizations discussed are National Council of Teachers of Mathematics (NCTM); Project 2061 of the American Association for the Advancement of Science (AAAS); National Research Council (NRC); National Committee on Science Education Standards and Assessment (NCSESA); Mathematical Sciences Education Board (MSEB); Scope, Sequence, and Coordination of Secondary School Science (SS&C) coordinated by the National Science Teachers Association (NSTA); Equity 2000, a program of the College Board; Department of Education; Eisenhower National Program, including the Eisenhower National Clearinghouse and the Regional Consortia for Mathematics and Science; Regional Education Laboratories; National Diffusion Network (NDN); and National Science Foundation (NSF) supporting Statewide, Urban, and Rural Systemic Initiatives. Contains 17 references. (MKR)

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Guide to Reform in Mathematics and Science Education: The Big Players

Publication of the Southwest Consortium for the Improvement of Mathematics and Science Teaching (SCIMAST)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
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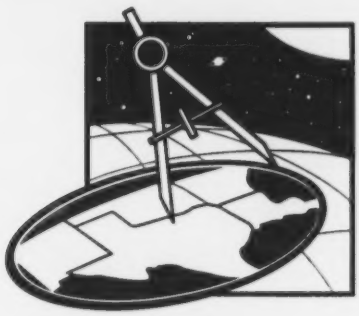

GUIDE TO REFORM IN MATHEMATICS AND SCIENCE EDUCATION: THE BIG PLAYERS

Summer 1994

This booklet is brought to you by the SCIMAST Project, part of SEDL, the Southwest Educational Development Laboratory, a nonprofit institution serving educators in five states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

Many organizations—both public and private—are involved in the current push for reform in science and mathematics education. Nationally based groups and local and statewide organizations proliferate with new suggestions and proposals for improving schools and their delivery systems. Many teachers, parents, and administrators cannot help but view this latest reform effort with a somewhat jaded outlook. What makes this desire for sweeping change different from the other reform movements that most educators have seen in the last 20 or 30 years? What incentive exists for teachers to change their practices when their experience leads them to believe that in a few years the pendulum will swing in another direction—perhaps knocking them off balance as it returns?

This cycle of reform does differ from previous efforts in that it presents opportunities for bottom-up reform rather than top down. Even programs with national scope are committed to local initiatives and to receiving input from local groups and educators. Teachers and parents can affect these efforts, but they can also become lost in the welter of acronyms and new approaches.

This guide to some of the players in science and mathematics education is selective, focusing on key players at the national level. We hope that it will help teachers and parents to orient themselves to the on-going reform efforts and to use the resources available in their areas so that they may make their concerns and interests part of the changing landscape.

Several organizations have been major forces in the reform of science and mathematics education. Generally speaking, these big players have contributed major ideas to the reform movement or have resources that have been useful in getting reform ideas disseminated to the public and to the education profession.

The **National Council of Teachers of Mathematics (NCTM)** has been the major impetus behind the reform of K–12 mathematics education. In 1989 the NCTM published *Curriculum and Evaluation Standards for School Mathematics*. When people refer to "the mathematics standards" they usually mean this book, which provides objectives for mathematics curricula and assessment that can build on present practices.

Two additional books cover standards for other aspects of mathematics teaching. In 1991 *Professional Standards for Teaching Mathematics* was published to show how teaching methods can complement the curriculum changes in the *Curriculum and Evaluation Standards*. Evaluation of teaching and the professional development of mathematics teachers are also covered in this volume.

A draft version of proposed assessment standards has been circulated for comment among educators and other interested people and will probably be ready in late 1994 or early 1995. NCTM believes that new assessment activities will be needed to accompany the changes proposed in the standards. Teachers and other educators will need models to help them design assessment that will reflect the letter and spirit of the standards.

NCTM has also published a practical, grade-oriented *Addenda Series* that is coordinated with the *Standards* documents. The series offers publications with instructional ideas and materials targeted in three broad age groups: grades K–6, 5–8, and 9–12. *A Core Curriculum: Making Mathematics Count for Everyone*, for example, concentrates on a common core curriculum for students in grades 9 through 12. The book offers several curriculum models, suggested syllabi, assessments, and sample lessons. Also within the *Addenda Series* are grade-specific booklets with practical field-tested activities that illustrate the themes of *Curriculum and Evaluation Standards*. The themes of problem solving, reasoning, communication, and connections are made concrete in classroom practices.

Sponsored by the American Association for the Advancement of Science (AAAS), **Project 2061** is another major player in the reform movement. With a broad aim of forming a consensus regarding the fundamental scientific concepts all U. S. school children should know, Project 2061 emphasizes scientific literacy of a common core of learning, integrates science and mathematics, and focuses on innovative teaching for grades K–12. Project 2061 was named for the next year that Haley's Comet will appear—a year chosen also as the end point of this current round of reform.

Project 2061 has consisted of three phases. Phase I culminated in the February 1989 publication of *Science for All Americans*, a major concept paper of the reform movement. Neither a curriculum document nor a textbook, *Science for All Americans* outlines fundamental science, mathematics, and technological skills, knowledge, and understanding all Americans should achieve by grade 12. The report presents a vision of students studying interdisciplinary themes throughout their school careers rather than moving through a prescribed set of unrelated courses.

Phase II worked the recommendations from *Science for All Americans* into specific suggestions contained in *Benchmarks for Scientific Literacy*. During Phase II alternative curriculum models for all grades in science, mathematics, and technology were created in six school districts. In the SEDL region, four school districts in San Antonio, Texas, made up such a test site; other sites included three rural counties in Georgia and sites in San Diego and San Francisco (California), Philadelphia (Pennsylvania), and McFarland, Wisconsin. Published in 1993, *Benchmarks* resulted from the experiences of these six sites. It is neither a curriculum nor a framework nor a curriculum plan but a tool that districts, schools, and educators can follow to design useful curriculum. The book is not expected to be followed in a specific set order but its goals are to be organized according to the needs of individual district plans. Now in Phase III, Project 2061 involves scientific societies, professional organizations, and other groups in collaboration to turn suggestions and blueprints into lasting educational practice.

While *Benchmarks for Scientific Literacy* is not intended to set standards for science education, an effort is underway to set scientific standards similar to the NCTM's mathematics standards. In the spring of 1991 the National Science Teachers Association (NSTA) formally asked the **National Research Council (NRC)**, the research arm of the National Academy of Sciences, to begin formulating K–12 standards in science. NRC staff have produced a series of *Science Framework Summaries*, incorporating a wide variety of ideas and information from such sources as state science frameworks, the work of Project 2061 and other programs, and science standards from other countries. These summaries have been made available to educators and other interested parties for comment. The NRC committee in charge of developing the standards is the **National Committee on Science Education Standards and Assessment (NCSESA)**, which is divided into three groups; one each deals with curriculum, teaching, and assessment standards. Working papers, drafts, and summaries have been circulated among communities of interest.

The NRC goal is to have curriculum, teaching, and assessment standards published by the end of 1994. These standards will suggest the framework for curricula, outline effective teaching strategies, and describe sample assessment tasks, projects, and portfolios.

The **Mathematical Sciences Education Board (MSEB)** provides a national overview of reform in school mathematics. Professional mathematics education associations created the MSEB in 1985 and it has collaborated with NCTM in the development of standards. The MSEB is one of three mathematics units at the NRC and it reports directly to the governing board of the NRC.

In 1989 MSEB published *Everybody Counts: A Report to the Nation on the Future of Mathematics Education,* which examined mathematics education as one system with curriculum, teaching, and assessment connected from kindergarten to high school. *Reshaping School Mathematics: A Philosophy and Framework for Curriculum* was published in 1990 and provided a supporting rationale for the NCTM *Curriculum and Evaluation Standards*. In 1993 MSEB produced *Measuring Up,* which presented prototypes of alternative assessment tasks.

Scope, Sequence, and Coordination of Secondary School Science (SS&C), coordinated by the NSTA with funding from the U.S. Department of Education and the National Science Foundation (NSF), has been another major force for new ideas in the reform movement. The project has focused on stimulating middle school students' interest in science out of a belief that after such formative exposure students will continue to be interested in the scientific disciplines. In April 1994 NSF awarded NSTA $4 million to begin work on using the SS&C approach at the high school level.

The SS&C middle school project has been site-based and in its initial phases used six pilot centers—in Alaska, California, Iowa, North Carolina, Puerto Rico, and Texas—to provide the basis for its strategies. The high school SS&C will provide implementation models, laboratory and activity suggestions, and scheduling strategies. The more specialized education of high school teachers, when compared to that of middle school teachers, will make integrated curricula, like the recommendations of SS&C, more difficult. In the SEDL region Houston will be a high school site. Other high schools will be in North Carolina, New York, Montana, California, Iowa, Puerto Rico, and Washington, D.C.

In 1992 SS&C published *The Content Core: A Guide for Curriculum Developers.* Not intended to define content to be taught, *The Content Core* is a method of organizing subject matter according to the project's three principles—scope, sequence, and coordination. *Scope* indicates a coherent science curriculum that covers all of the secondary school years with "less is more" as the guiding principle in both teaching and curriculum development. *Sequence* conveys the idea that science education must not only appropriately sequence instruction but also take into account the ways different students learn. Concepts, principles, and laws of science must be introduced at successively greater levels of abstraction as a student moves through the school years. *Coordination* indicates that, since the sciences share topics and processes, their integration must be made clear for students. Organization of science education around these three principles should restructure the approach of U. S. secondary schools, which typically teach biology in 9th grade, chemistry the next year, and physics last without making theoretical or experiential connections between the sciences.

A program of the College Board, **Equity 2000** is designed to increase the college entrance and graduation rates of minority students by restructuring mathematics programs. Under the curriculum envisioned by Equity 2000 all 8th graders would take a pre-algebra course, 9th graders would take Algebra I, and tenth graders would take geometry. The program offers teacher inservice training during both the summer and the academic year, offers workshops and follow-up for counselors, and tries to involve

parents in the program. A variety of evaluations measure student achievement and attitudes toward college, parental attitudes, indications of systemic change, and extent of college participation.

Equity 2000 requires the participation of an entire school system in its program. The program began with six systems; one was in Fort Worth, Texas. Other sites were in Milwaukee,Wisconsin; Nashville, Tennessee; Prince George's County, Maryland; Providence, Rhode Island; and San Jose, California. Now 12 systems, with 600 schools, are involved in the program. All of the sites have significant numbers of minority or disadvantaged populations.

Several federal entities are important to the reform of science and mathematics education, but two in particular, the U. S. Department of Education and the National Science Foundation, are examined here. These governmental organizations can support professional development, curriculum change, systemic change, and information dissemination through the deployment of their funding resources.

The **Department of Education (ED)** has several programs involved in the reform of mathematics and science.

- The **Eisenhower National Program** is a federally funded program administered by the Office of Educational Research and Improvement (OERI) to support science and mathematics teaching and learning at state and local levels. The program has funded state-level projects that emphasize systemic reform of K–12 mathematics and science education and has supported the National Research Council's national content standards for science. The national program also supports the following projects.

  The ED uses Eisenhower funds to support the development of **State Curriculum Frameworks for Mathematics and Science Education.** Fifteen states and the District of Columbia—including Arkansas and Louisiana in the SEDL region—are developing curriculum frameworks to implement systemic mathematics and science reform. Some states are also developing guidelines for teacher education and certification and professional development inservice programs coordinated with the new frameworks.

  The **Eisenhower National Clearinghouse**, based in Columbus, Ohio, is also supported by Eisenhower funds and serves as a center for information on science and mathematics education reform for grades K–12. The Clearinghouse is developing a database of instructional materials, methods, and assessment resources. The information will be accessible through Internet and will be available by print, video, audio, software, and CD-ROM media.

  Eisenhower funds also support ten **Regional Consortia for Mathematics and Science,** which are housed in the ten regional educational laboratories (RELs). The consortia support regional, state, and local reform initiatives for statewide systemic change in mathematics and science education. They provide technical assistance and information to implement programs that offer access for all students and that reflect the emerging mathematics and science standards. Consortia staff also model effective teaching and assessment practices through intensive professional development activities. SCIMAST is one of these ten consortia.

- The ten **Regional Educational Laboratories (RELs)** are funded by the Office of Educational Research and Improvement (OERI) of the ED. Founded during the Johnson administration, the RELs identify the education needs of their regions and develop programs to meet those needs. The RELs conduct research on education issues, publish, and provide professional development programs for teachers and other educators. Together the ten laboratories have established the Laboratory Network Program to coordinate national reponses to educational needs. SEDL serves Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

- The **National Diffusion Network (NDN)**, within the OERI, provides schools with a selection of exemplary programs and practices. Each year the NDN catalog, *Educational Programs that Work*, presents updated descriptions of programs that appeared in previous editions along with information on new programs that have been judged exemplary. The NDN has also produced a selection of its collection, *Mathematics, Science, and Technology Programs that Work* and offers assistance in implementing successful practices. Additionally, NDN funds a facilitator in each state who can match NDN programs with interested schools and other organizations.

Another federal agency, the **National Science Foundation** supports the **Statewide Systemic Initiatives (SSI)** to increase both the pace and the effectiveness of improving science and mathematics education. Projects must be long-term and have evidence of commitment from the state's governor, chief state school officers, teacher organizations, legislature, corporations, and presidents of colleges and universities. Projects must show a commitment to reforming science and mathematics education in a "systemic" way by offering proposals to streamline and coordinate many levels, such as teacher recruitment, preparation, and retention; professional development; and changes in teaching methods or in curriculum. Projects may be housed in government offices, universities and colleges, or other administrative entities but must show collaboration among state interests affected by science and mathematics education.

Within SEDL's region, Arkansas, Louisiana, New Mexico, and Texas have received SSI funds. To coordinate changes in curriculum, teacher education, leadership, partnerships and policy, the Arkansas SSI will establish five regional service centers, which will identify innovative curricula and provide schools the equipment needed to carry out reform. The focus of the Louisiana SSI has been preservice and inservice change, modification of certification for elementary and middle grades, and updating curriculum and materials. The New Mexico SSI has established five regional centers to provide teacher training and technical assistance in implementing science and mathematics reform. In addition, Partnering and Change Agent Teams have been established and six universities offer summer institutes for teachers and administrators. The Texas SSI is developing and educating constituencies within the state to support reform, especially restructuring existing curriculum.

NSF also has initiated the **Urban Systemic Initiatives (USI)** and **Rural Systemic Initiatives (RSI)**. No implementation grants have been awarded in these programs as of yet, but they are designed to address the need for long-range improvements in science and mathematics education in disadvantaged rural regions of the country and in large metropolitan areas. The USI emphasizes collaboration among schools, professional organizations, governmental entities, community-based organizations, informal science organizations, parents, and others. The RSIs also use collaboration, but tend to emphasize the development of infrastructure and technological instruction more than do other programs.

Other Content Areas

Standards are being developed for other content areas as well. In English, geography, and history only content standards are being developed now. In the arts, civics and government, economics, foreign languages, physical education, and social studies performance or evaluation standards are being developed in addition to content standards. Vocational education is developing national industry standards. All projects are slated to be completed by the fall of 1995, except for the economics performance standards, which are scheduled for release in 1997.

If this simplified tour through the thicket of science and mathematics reform has intrigued you, you may want to contact some of these big players for ideas or ways to become involved in your area. The following numbers may help you find specific ways these groups are affecting reform in science and mathematics instruction.

The Numbers

Eisenhower National Program
U. S. Department of Education
400 Maryland Ave., SW
Washington, D.C. 20202
(202) 219-2126

The ED Office of Educational Research and Improvement has a toll free telephone line that can be called for information on programs and publications: (800) 424-1616

Eisenhower National Clearinghouse
for Mathematics and Science Education
1929 Kenny Road
Columbus, OH 43210-1079
(614) 292-2802

Equity 2000
The College Board
45 Columbus Avenue
New York, NY 10023-6992
(212) 713-8268

Mathematical Sciences Education Board
2101 Constitution Ave., NW
Harris Bldg. 476
Washington D.C. 20418
(202) 334-3294

National Council of Teachers of Mathematics
1906 Association Dr.
Reston, VA 22091-1593
(703) 620-9840

National Diffusion Network
Office of Educational Research and Improvement
U. S. Department of Education
555 New Jersey, NW
Washington, D.C. 20208-1525
(202) 219-2135

National Research Council
2101 Constitution Ave., NW
Washington, D.C. 20418
(202) 334-2000

National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230
(703) 306-1703

National Science Teachers Association and
Scope, Sequence, and Coordination of Secondary School Science
1840 Wilson Blvd.
Arlington, VA 22201
(703) 243-7100

Project 2061
AAAS
1333 H St., NW
Washington, D.C. 20005
(202) 326-6666

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This booklet is a publication of the Southwest Consortium for the Improvement of Mathematics and Science Teaching (SCIMAST) sponsored by the U.S. Dept. of Education under Contract No. R168R20003-94. The content does not necessarily reflect the views of the department or any other agency of the U.S. government. SCIMAST is part of the Southwest Educational Development Laboratory (SEDL), 211 East Seventh Street, Austin, Texas 78701. (512) 476-6861 / (800) 201-7435.